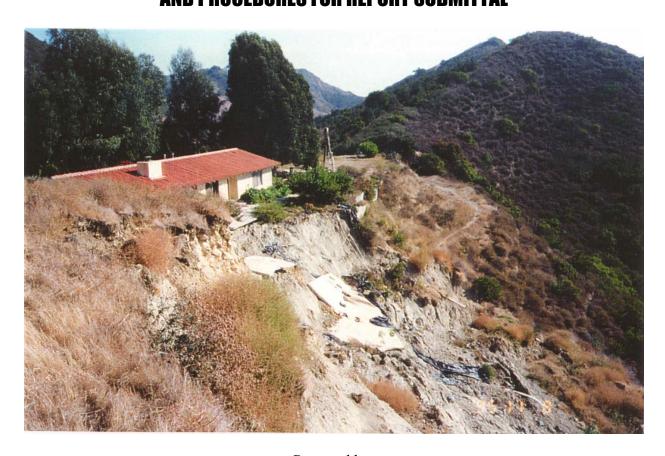


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City Geotechnical Staff

GUIDELINES FOR THE PREPARATION OF ENGINEERING GEOLOGIC AND GEOTECHNICAL ENGINEERING REPORTS AND PROCEDURES FOR REPORT SUBMITTAL



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1 INTRODUCTION

1.1 Purpose

These guidelines provide the minimum standards and recommended format for engineering geologic and geotechnical engineering reports submitted to the City of Malibu. The guidelines do not specify the engineering methods or scope of study for individual development projects. Nevertheless, these guidelines provide specific requirements that impact the scope and in some cases the engineering methods that are required to meet minimum standards for acceptance. It is not the intent of this document to supplant the engineering judgment of the project professionals. In addition, these guidelines explain the procedures for submitting the project to City geotechnical staff (CGS) for review both in the planning and building and safety stages. Non-compliance with these guidelines could lengthen the geotechnical review process and delay project approval. These guidelines have been adopted by the City of Malibu.

1.2 Definition of Roles

Registered and licensed professionals under contract with the City of Malibu conduct technical review of engineering geologic and geotechnical engineering reports and plans.

City Geologist (CG)

At the request of the Building Official, the City Geologist reviews engineering geologic reports, building and/or grading plans, and as-built engineering geologic reports for proposed projects. Submitted documents (e. g. plans, reports) are reviewed, following a field reconnaissance to evaluate the geologic site conditions and the adequacy of the applicant's engineering geologist's assessment of the project. If reports were not submitted with the plans, a determination of the need for reports will be made based on the field reconnaissance. Emphasis is placed on the effect of geologic conditions on the proposed development and the effect of the proposed project on the offsite properties. The Building Official and applicant will be notified of known potential geologic hazards associated with development. In addition, the City geologist will review reports to assure that they comply with the guidelines established herein and with those portions of City codes and ordinances and state-mandated codes and acts (laws) dealing with geologic conditions.

City Geotechnical Engineer (CGE)

At the request of the Building Official or City Geologist, the CGE reviews geotechnical engineering reports and any related documents (e. g. geology reports, building plans, grading plans) from a geotechnical engineering perspective for the proposed development.

The reports and related documents are reviewed to evaluate the applicant's geotechnical engineer's assessment of the development and to notify the Building Official and applicant of potential hazards associated with the development.

<u>General</u>

The CG and CGE prepare written comments presented in a geology and geotechnical engineering review sheet that discusses engineering geologic and geotechnical engineering related issues. Any issues regarding established City policies and procedures are not within the scope of the CG and CGE's work and are determined by the Building Official. The CG and CGE do not approve any project. They simply provide geologic and geotechnical input and advice to the City Building Official and make recommendations to the City as to either require more information, or consider approving the project from engineering geologic and geotechnical engineering perspectives. The Building Official determines whether or not to issue a building permit for a development project.

Project Applicant

Applicants include developers, land owners, permit specialists, home owners, contractors, and others directly involved with development and remediation activities. Applicants are responsible for submittal of complete documents for geotechnical review and payment of deposits and fees due upon permit issuance.

Project Geotechnical Consultants

Appropriately registered and licensed consulting professionals provide engineering geologic and geotechnical engineering services for the project applicants. Consultants typically provide two levels of services for the applicant-the first level is to provide data and analyses to determine feasibility of the site for development with regard to geologic and geotechnical hazards (planning stage items), and the second level is to provide design recommendations, review and approve project plans and specifications, provide construction observation services, and as-built reports (building and grading stage items).

1.3 Applicable Codes

The current codes and ordinances that are applicable to developments within the City of Malibu include the California Building Code. Unless otherwise stated, the versions of codes adopted by the City are the applicable codes in effect. Applicants and consultants may find the applicable codes on the City's Internet site at http://www.ci.malibu.ca.us.

These guidelines do not supercede applicable Federal, State, and Local Codes. In particular, geotechnical engineering and engineering geological reports must comply with:

- Alquist-Priolo Earthquake Fault Zoning Act of 1972.
- Seismic Hazards Mapping Act of 1990.

In addition to applicable codes and guidelines, applicants and consultants should be familiar with the selected references listed in Appendix A.

1.4 Courtesy Calling

The City of Malibu's geotechnical staff has a policy of "courtesy calling" that facilitates and encourages communication between the reviewer and the project geotechnical consultants or applicant and other professional consultants, as necessary. This policy allows the reviewers to discuss concerns and advise the project geotechnical consultants about resolving issues regarding both feasibility of the proposed development and building plan check items. This policy helps to avoid long review processes that involve numerous written iterative responses. Consultants are urged to contact City geotechnical staff at their convenience to discuss review comments and get answers to questions regarding current Codes, Policies, and Ordinances in the City.

2 PROCEDURES - SUBMITTAL OF DOCUMENTS FOR ENGINEERING GEOLOGIC AND GEOTECHNICAL ENGINEERING REVIEW

2.1 Pre-Planning Review

City geotechnical staff recognizes that applicants sometimes want assurance that vacant properties are buildable from both engineering geological and geotechnical engineering perspectives. With permission from the Building Official, City geotechnical staff can review projects as part of a pre-planning review (aka, pre-application review). Reports and a deposit are collected (as discussed below), and the project is reviewed only for geological and geotechnical feasibility. Planning stage "in-concept" approval cannot be granted from City geotechnical staff until a formal application for the project is submitted to the Planning Department. Please contact the City Geologist at 310-456-2489, x306 regarding this matter.

2.2 Planning Stage "In-Concept" Review

The first step in the permitting process is the submittal of an application and documents to the City's Planning Department for approval "In-Concept". The procedure for the planning stage review process is shown on Plate A. City geotechnical staff (CGS) has provided planning department personnel lists of development projects that do and do not require geology or geotechnical review in the planning stage (Plate B). Those projects that do not require review should not be forwarded to CGS. If the project requires a planning stage review, the applicant receives a Geology Referral Sheet from planning staff (PLATE C). The applicant should take this referral sheet to CGS during public counter hours on Mondays or Thursdays between 8:30 AM-12:30 PM. CGS will make a determination over the counter as to the types of reports required for review prior to "in-concept" approval. Any questions regarding whether the proposed development project will require geotechnical review in the planning stage can be addressed by CGS during public counter hours.

The planning stage review is performed from the perspective of whether or not the project appears geologically and geotechnically feasible within the City's codes and ordinances.

Details of the foundation design are not reviewed until the building plan check stage. If sufficient data and analyses are presented that demonstrate feasibility, recommendations are presented by the CG and CGE (if needed) that the City consider planning stage approval or "approval in concept".

2.3 Building and Grading Plan Check Stage Review

Once the project is approved by the Planning Department and approval from the California Coastal Commission is granted, the applicant may submit plans to the Building and Safety Department for Building (and Grading) plan check review. The Building and Safety Department also allows for plan check review of the City's approval "in-concept" plans concurrent with the California Coastal Commission review. In some instances, engineering geological and geotechnical reports and related plans should be submitted to the City for review by the CGS. Most geotechnical consultants that currently perform work in the City include building and grading plan design recommendations in their reports that are submitted for "in-concept" review in the planning stage. In other instances, engineering geologic and/or geotechnical engineering reports and related plans are required for review by CGS only in the Building plan check stage.

The process for reviewing geotechnical and geologic reports in building plan check is illustrated on Plate D. If adequate data and analyses are presented to substantiate the Project Engineer and Geologist's recommendations, and if the Project Consultant's recommendations appear prudent and pose no threat to public safety, CGS will recommend that the City Building Official consider approval of the project from both engineering geologic and geotechnical engineering perspectives, respectively.

2.4 Submittal Requirements

If it is determined that the proposed development project requires review by City geotechnical staff, the following items must be submitted to City geotechnical staff during public counter hours at City Hall, Mondays or Thursdays between 8:30 AM-12:30 PM:

- Two copies of engineering geologic and/or geotechnical engineering reports that are wet stamped and manually signed by the project engineering geologist and project geotechnical engineer.
- Two sets of dated development plans (two of the sets of plans that are submitted to the Planning or Building
 and Safety Departments, depending upon whether the submittal is for feasibility or plan check review).
 Drainage plans depicting all surface and subsurface nonerosive drainage devices, flow lines, catch basins, etc.,
 shall be included in the building plans.

• A deposit for \$1250.00 (check made out to the City of Malibu). Please note that the applicant is entitled to a refund if the review process does not utilize the entire deposit. The City retains a base fee of \$250.00 from the deposit. Refunds can be requested in writing to the Building Official once the building permit(s) is(are) issued (see attached Refund Request Form, Plate E). If the review process incurs costs which exceed the deposit, the applicant will be required to pay the balance of the costs prior to "in-concept" approval in the planning stage or prior to permit issuance in the building stage.

City geotechnical staff will review the project, which includes a site visit that will be scheduled with the applicant, and a geology and geotechnical engineering review sheet will be issued to the applicant in 10 working days. Complex sites, including multi-family and commercial developments, and subdivisions, may entail longer review periods. CGS will evaluate the reports for completeness and conformance to standards of practice and to City, County, and State Code requirements. The review sheet will recommend either: 1) approval of the project "in-concept" in the planning stage, or 2) the project is not approved in the planning stage, with comments to be addressed by the project geotechnical consultants prior to planning stage approval. Letters issued during the planning stage will include items to be addressed prior to building/grading plan check stage, as most reports include recommendations for building/grading plan check items.

Building or grading plan check reviews (only) may only require a deposit of \$625.00, depending on the scope of the project.

Faxed reports will not be accepted for submittal.

Please do not hesitate to contact City geotechnical staff at 310-456-2489, x306 if there are any questions regarding these requirements.

2.5 Geologically Complex Areas

The City allows small room additions (not exceeding 250 square feet) without the necessity of establishing a safety factor of 1.5 against potential slope failure. This is only applicable if the site is in an area that is not designated as "geologically complex" as determined by the CG during public counter hours on Mondays or Thursdays between 8:30 AM-12:30 PM.

2.6 Fire Rebuild Guidelines

The City of Malibu's Fire Rebuilding-Geology and Geotechnical Guidelines, revised June 1, 1994, are no longer applicable. Re-development of properties destroyed in the Malibu-Old Topanga firestorm of November, 1993 will be considered new development, and will fall under jurisdiction of the City's current guidelines.

3 GUIDELINES

The guidelines contained in the following sections have been prepared for the purpose of providing a general format and minimum requirements for analysis and report preparation for reasonably good quality, preliminary reports and design recommendations for development. The most common factors that contribute to geologic/geotechnical review concerns (thus, delaying the review/approval process) are related to the omission or lack of supporting data. It is hoped that these guidelines can assist in avoiding such problems and to aid in expediting the processing of grading and building permits. In all cases, the data presented in the report should substantiate the conclusions and recommendations.

Utilization of these guidelines will enable the applicant's project geotechnical/civil engineer and project engineering geologist to provide data necessary for the design engineer/architect to more accurately understand the geologic setting and thus to best prepare a safe and cost-effective design that will be compatible with inherent environs. The guidelines have been prepared to serve only as a reference during both preparation and review for those striving to

assure the processing of permits in an expeditious manner. Furthermore, subjects addressed in these guidelines are not meant to be all inclusive, but to cover areas that concern the majority of projects in the City of Malibu.

The CG and CGE anticipate that the Project Engineer and Geologist shall provide the City of Malibu with all the available technical data and first-hand information of the site geologic and geotechnical conditions that are obtained during the course of exploration, laboratory testing, and subsequent evaluation and analysis. To best facilitate an effective, efficient, and economic exploratory program, it is strongly recommended that the exploratory needs of the Project Geologist and Project Engineer be integrated and coordinated to assure the best possible product. To minimize potential failure and ensuing losses resulting from improper care and maintenance after construction, the Project Engineer and Geologist's recommendations should be implemented and the recommended site maintenance should be recognized and adhered to. Conformance to the guidelines and approval of the grading and/or building permits by the City of Malibu should not be construed in itself as an assurance of safe performance of the proposed development.

3.1 Types of Projects

3.1.1 New Residential and Commercial Construction

These projects include new single-family residences, multi-family structures, commercial/industrial buildings, detached guest houses, and detached studios (those considered habitable by Code). Projects involving the redevelopment of existing sites are considered new construction (example: demolish single-family residence and construct new residence). Comprehensive engineering geologic and geotechnical engineering reports are required that conform to the City's Guidelines and all applicable Codes and Ordinances.

3.1.2 Remodels

Projects include interior remodels of existing structures, including conversions of existing buildings from one occupancy to another in accordance with the current Building Code. No review by CGS will be required if no new foundations are part of the remodel or conversion. Remodels requiring an enlargement of the private sewage treatment system in landslide-prone areas such as Big Rock Mesa, La Costa, Las Flores Mesa/Eagle Pass, and Malibu Road may require some level of review, determined by CGS on a case-by-case basis (see Plate B). Geotechnical recommendations addressing modifications to existing foundations, new foundations, underpinning foundation elements, floor slabs, and upgrades to the current Building Code may be required on a case-by-case basis.

3.1.3 Additions to Existing Structures

Projects may include first-floor, second-floor, and two-story additions to existing single-family residences, multi-family structures, commercial structures, detached garages, detached guest houses, detached studios, detached pool houses/cabanas, and barns. Requirements for geotechnical engineering and engineering geologic reports will vary depending on the square footage of the addition compared to the square footage of the existing structure, whether the addition encroaches toward a slope or geotechnical hazard, whether the additions provide additional loading on existing foundations, and whether the addition is a second-story addition with no increase in footprint square footage to the existing structure.

3.1.4 Swimming Pools/Spas

Appendix 420 of the Building Code defines a swimming pool as, "...any structure intended for swimming or recreational bathing that contains water over 24" deep. This includes in-ground, above-ground, and on-ground swimming pools; hot tubs; portable and nonportable spas; and fixed in-place wading pools." The attached Pool/Spa Submittal Requirements (Plate F) adopted by the City (June 20, 1996) include all geotechnical requirements for swimming pools.

3.1.5 Repairs to Existing Structures/Remedial Grading

Projects include repairs to existing structures and properties damaged by storm surges and wave action, landslide movement, liquefaction, earthquakes, flooding, fires, wood rot and fungi, and other natural disasters. Geotechnical engineering and engineering geological reports may be required, to be determined on a case-by-case basis by CGS in accordance with the City's current Building Codes and Ordinances. Reports should address causes and scope of damage, as well as repair alternatives in accordance with standards of practice and the City's Guidelines. Recordation of an "Assumption of Risk and Release" for geotechnical hazards may be required prior to permit issuance. Whenever a repair (corrective work performed to protect existing structures) is required, it shall be designed to meet all existing standards within theses these guidelines unless specific exemption is granted by the City's Building Official (e.g., in the event of an emergency).

3.2 Types of Studies/Reports

Geotechnical engineering and engineering geologic reports may be prepared by geotechnical consultants for a variety of scopes of services depending on the proposed development project and the stage of review (planning or building/grading plan check). Each report submitted should clearly indicate the purpose and scope of the study as well as the proposed development as discussed in the previous section.

3.2.1 Feasibility/Preliminary Design/Design-Level Reports

Feasibility studies, including EIR documents, shall focus on feasibility of the proposed development and potential impacts that the proposed land uses could have on the geologic environment. Specific mitigation measures are not required at this stage. It must be demonstrated, however, that all potential geotechnical hazards that may affect the proposed development can be mitigated.

Preliminary Design Reports address a project at the stage where general development plans have been prepared, although specific development plans may not be available. Preliminary design reports discuss the feasibility of site development for a particular development concept and provide general recommendations for site development. Both Feasibility Reports and Preliminary Geotechnical Reports are often prepared in advance of detailed building or grading plans. Therefore, a supplemental Building/Grading Plan Review Report may be required to insure that the actual building and grading plans comply with the preliminary geotechnical recommendations.

Design-level reports provide site-specific design recommendations related to a specific development concept but frequently precede development of grading and/or building plans. Studies at this stage shall relate to specific design recommendations and mitigation of engineering and geologic hazards as they relate to grading and building of the proposed development. For many projects the preliminary design report is intended by the applicant to serve also as the feasibility design report and the design-level report due to time constraints. In such cases, minor or major changes can occur in development plans between the time the geotechnical report is prepared and time of submittal. Depending on the magnitude and type of changes, additional geotechnical work may be required, and a Building/Grading Plan Review report may be required (Section 3.2.4). When the current development plan differs significantly from that which the geotechnical report was prepared, but in the opinion of the Geotechnical Consultant additional geotechnical work is not required, a letter would be required when the plans are submitted for review stating the Consultant has reviewed the current plans and that the recommendations in the geotechnical report are still applicable, or provide revised recommendations as appropriate.

Exemption: The Building Official may exempt small additions and remodel projects from report requirements. Exempted projects, however, must not be located within Seismic Hazard Zones, Fault Hazard Management Zones, or hilly areas. See Section 6.1.1 for exemptions to field exploration requirements.

3.2.1.1 Seismic Hazard Evaluation Reports

Geotechnical reports for sites within a Seismic Hazard Zone, as identified in accordance with the Seismic Hazards Mapping Act, shall include a section evaluating seismic hazards, or a separate report shall be provided meeting all

requirements set forth in said Act. Seismic hazards should be addressed in accordance with the Seismic Hazards Mapping Act, 1990. Seismic Hazards Maps, published by the California Division of Mines and Geology (CDMG), include the Topanga Quadrangle, released in April, 1997 and Malibu Beach Quadrangle, released in late 2001. The Pt. Dume and Triunfo Pass Quadrangles were released as final maps in February, 2002. These maps are available for review and reproduction at City Hall. The City, following approval, will forward one extra copy of the geotechnical report to the State Geologist (CDMG).

3.2.1.2 Fault Rupture Hazard Reports

The State of California, Division of Mines and Geology (CDMG), has zoned two areas of Malibu as an Earthquake Fault Zone in accordance with the Alquist-Priolo Earthquake Fault Zoning Act of 1972. These maps are available for review and reproduction at City Hall. The City's requirements regarding fault rupture hazard studies are outlined in Section 5.1.1. Requirements depend on the location of the proposed development project in the City, and the scope of the project. Special studies may be arranged between the applicant's geotechnical consultants and City Geologist on a case-by-case basis. One extra copy of the geotechnical report should be forwarded to the State Geologist (CDMG) by the applicant following approval.

3.2.2 Geologic Reconnaissance Reports

This report includes a review of the City's files on the site and adjacent properties, regional geologic and geotechnical maps, pertinent pairs of stereographic aerial photographs, and a site reconnaissance. No subsurface exploration is usually required, but the report must be prepared by and signed by a state-certified engineering geologist.

3.2.3 Geotechnical Engineering Reconnaissance Reports

This report includes a review of the City's files on the site and adjacent properties, a discussion of existing geotechnical conditions on the site, an evaluation of proposed geotechnical work on the site, and a site reconnaissance. The engineer should address any potential geotechnically related hazard and provide recommendations as to the need for any additional geotechnical data and analyses. Subsurface exploration is usually not required, but this report must be prepared by and signed by a state-licensed civil engineer practicing in geotechnical engineering or a state-registered geotechnical engineer.

3.2.4 Building/Grading-Plan Review Reports

Building/Grading Plan Review reports entail the review of these plans for conformance with the site-specific approved geotechnical engineering recommendations. Grading and building plans reviewed and deemed acceptable for construction by the Project Geotechnical Consultants shall indicate that the plans conform to all the recommendations made in the applicable reports. Reports shall be signed and wet-stamped by the Project Geotechnical Engineer and Engineering Geologist, as appropriate. If the latest geotechnical report is based on the current building and grading plans or one with only minor revisions, a review, signing, and stamping of the current building and grading plans will be acceptable without the submission of a separate new geotechnical review report. Specific requirements are discussed later in these guidelines, however, typical issues which should be addressed are:

- Specific grading recommendations (in conformance with the current building Code)
- Specific surface and subsurface drainage recommendations
- Slope stability mitigation (buttress fills, stabilization fills, slope trims or lay-backs, soldier pile stabilization)
- Settlement mitigation
- Liquefaction mitigation
- Construction stabilization and shoring plans and specifications
- Foundation recommendations
- Retaining wall recommendations
- Swimming pool design recommendations
- Flatwork recommendations

3.2.5 Update Reports

Update reports from geotechnical consultants may be required when:

- The scope of the project changes.
- Professional registration of consultants expires (existing reports).
- Site conditions change.
- Previous reports are sufficiently old so as to be outdated with regard to industry standards of practice or building codes.
- At the discretion of the Building Official.

The report shall: describe the currently proposed development, include a site reconnaissance, plan review, and reference prior reports. The update report shall state if all recommendations of the prior report(s) are applicable, or provide revised recommendations, as appropriate.

3.2.6 As-Built Compaction Reports

These reports should be prepared upon completion of grading of a site by a state-licensed civil engineer practicing in geotechnical engineering or a state-licensed geotechnical engineer. City geotechnical staff or the Building and Safety Department will determine whether a site requires the applicant's geotechnical consultant to prepare this report, depending on the scope of grading. City geotechnical staff will include this requirement as a comment on their building or grading plan check review sheets. Reports shall comply with the City's Building Codes.

As-built compaction reports shall include, but not be limited to, the following:

- Results of all in-place density tests and maximum density determinations.
- Results of all expansion index tests.
- Deep (pile) foundation observations and documentation.
- Results of revised as-built slope stability analyses (if warranted).
- Documentation of all footing inspections and bottom approvals.
- Results of all settlement monitoring.
- A map depicting the limits of grading, locations of all density tests, removal bottom locations and elevations, keyway bottom locations and elevations, all keyway, cleanout, and swimming pool subdrain locations and flow line elevations, and all retaining wall backdrain locations and flow line elevations.

The dry density and moisture content data shall be presented in a form to show in-place values along with the associated laboratory maximum dry densities and optimum moisture contents. All failed tests shall be clearly marked along with the associated re-tests.

The Project Geotechnical Engineer and Project Engineering Geologist shall make any comments as appropriate and sign the "as-built" grading plans.

An as-built geotechnical report shall also be prepared to document the installation of deep foundations.

Footing and slab inspections shall be documented in field memos, which are submitted by the Geotechnical Consultant to a field representative of the building official, along with results of expansion index tests to confirm the expansive characteristics of the supporting materials.

3.2.7 As-Built Engineering Geologic Reports

These reports should be prepared upon completion of grading of a site by a state-certified engineering geologist. City geotechnical staff or the Building and Safety Department will determine whether a site requires the applicant's engineering geologic consultant to prepare this report, depending on the scope of grading and geologic conditions exposed. The engineering geologic report shall discuss geologic conditions exposed during grading, provide additional recommendations for the proposed development (along with the geotechnical engineering consultant, if necessary) if unusual or unexpected conditions are encountered, and include a map depicting the geologic conditions exposed during grading.

3.3 Change of Consultant Letters

Written notification will be required if a change in geotechnical consultants occurs after the review process has been initiated or ownership of the property has changed. The letter must state that the new consultants have reviewed the work by the previous consultants, concur with their recommendations and conclusions, and agree to assume responsibility as geotechnical consultants of record from this point forward. If they do not concur with the previous consultants' conclusions and recommendations, additional subsurface exploration, testing, and analyses may be warranted. Two copies of the letter that are wet stamped and manually signed by the new project geotechnical consultants shall be submitted to City geotechnical staff for review and the City's files. No new permits shall be issued for a project, and all previously permitted work shall stop until the City is officially notified of the name, address, and telephone number of the new project engineering geologist and geotechnical/civil engineer, or as otherwise approved by the Building Official.

3.4 Level of Professional Responsibility

Geologic Work: In accordance with the Geologist and Geophysicist Act, "...all geologic plans, specifications, reports, or documents shall be prepared by a registered geologist, or registered certified specialty geologist, or by a subordinate employee under his direction. In addition, they shall be signed by such registered geologist, or registered certified specialty geologist or stamped with his seal, either of which shall indicate his responsibility for them." All documents that include engineering geologic data, interpretations, or recommendations must be manually signed by a California Certified Engineering Geologist (CEG), including license number and expiration date.

Geotechnical Engineering Work: In accordance with the California Business and Professions Code, foundation and geotechnical investigations and engineering reports must be prepared by either a registered geotechnical engineering or a licensed civil engineer with experience in geotechnical engineering. All documents that include engineering data, interpretations, or recommendations must be manually signed and wet stamped by a registered Geotechnical Engineer (GE) or a licensed Civil Engineer (RCE) with experience in soils or geotechnical engineering, including license number and expiration date. Certain projects, including essential facilities and schools, require a licensed geotechnical engineer.

4 GUIDELINES FOR CONTENT OF GEOTECHNICAL REPORTS

Geotechnical work includes both engineering geology and geotechnical engineering. This section provides specific guidelines related to report content for various aspects of most geotechnical reports.

4.1 Geotechnical Reference Standards

In general, all geotechnical and geologic reports shall comply with the most recent versions of appropriate standards, codes, and professional guidelines. The citations for some of the appropriate references are included in Appendix A.

4.2 Report Organization

All geotechnical reports shall include the following items, as appropriate for each project. Project geotechnical

consultants determine the specific report format.

- Purpose Clearly state the purpose of the report.
- Site Description Describe the existing site conditions including:
 - o Site Location, including address and cross streets.
 - o Site Topography.
 - o Site Drainage.
 - o Existing Structures & Improvements.
 - o Adjacent Properties, in particular, closely located structures, subterranean structures, and slopes that may affect the proposed development.
- Proposed Development Reports shall contain a description of the proposed development. The proposed developments shall be clearly shown on plans and cross-sections.
- Field Exploration Describe the field exploration, methods of excavation, methods and type of sampling, provide exploration logs, and include dates of exploration.
- Materials Testing Describe the laboratory testing procedures and test results, and provide graphical laboratory test sheets.
- Geotechnical Analyses and Findings Describe the analyses performed and the technical findings. At a minimum, the geotechnical report shall specifically address each of the following potential hazards:
 - Seismic hazards.
 - o Expansive soil.
 - Hydroconsolidation potential.
 - o Slope stability, including mud and debris flows and rockfall hazards.
- Conclusions.
- Recommendations.
- Figures The following figures shall be included with each report:
 - o Site Location Map.
 - o Regional Geologic Map.
 - o Seismic Hazard Map (for sites near liquefaction or landslide hazard zones and fault management zone).
 - o Geotechnical Map (40-scale or less).
 - o Geotechnical Cross Sections (as required per Section 4.3.4).
- Signatures of Registered Professionals.
- References as appropriate (see Section 4.5 Technical Documentation).
- Appendices as appropriate (see Section 4.5 Technical Documentation).

4.3 Maps, Plans, and Cross Sections

4.3.1 Site Location Map

A map with a north arrow and scale shall be provided for all projects that shows the site and surrounding area, encompassing a large enough area to easily and accurately locate the site on regional maps.

4.3.2 Regional Geologic Hazard Maps

Regional geologic hazard maps depict conditions that extend beyond the site geologic map. Regional geologic hazard maps may be used to locate and generate geologic cross-sections that extend offsite, especially where sites encroach into hillside areas. For example, sites along the south side of Pacific Coast Highway, in addition to a site-specific geologic map, might need a regional geologic map and cross-sections to depict slopes north of the highway that may affect the site.

Copies of seismic hazard maps showing the site location are required for all sites located inside or within 500 feet of a Seismic Hazard or Fault Zone.

4.3.3 Site Geotechnical/Geologic Maps

A site geotechnical map depicting the site and immediate area surrounding the site is required for all projects. The following shall be depicted on the site specific geotechnical map:

- Existing onsite structures and closely located offsite structures that have the potential to interact with the proposed development.
- Proposed improvements.
- Limits of earth units across the site.
- <u>All</u> exploratory borings and trenches/test pits known to exist on the site.
- All geologic cross-section lines.
- Geologic data from all subsurface excavations and surface mapping (where applicable).
- An explanation that clearly defines all contacts, symbols, lithologic units, and other relevant data shown on the map.

The site-specific geologic/geotechnical map for projects with significant grading shall use an accurate topographic base map and a scale sufficient to clearly depict the details of the proposed development and geologic and soil conditions. The base map shall clearly indicate the map scale, true north, and who prepared the map.

4.3.4 Geotechnical Cross Sections

Cross sections are required to depict interpreted geologic conditions underlying the site. Cross-sections shall be drawn where natural, cut, or fill slope heights or basement, retaining wall, or temporary/permanent excavation exceeds 10 feet, or when an excavation extends below a 1(H):1(V) from adjacent foundations. Cross sections shall clearly show site boundary locations, location and size of all existing and proposed structures, locations of all exploratory excavations, contacts between earth units, intersections with other cross-sections, and the extent of proposed grading and overexcavations.

Geologic data, including the measured and the highest anticipated groundwater conditions across sites in both flat, alluvial areas and hillside areas, shall be reasonably interpreted throughout the length of the section. Worst-case geologic and soil conditions (the most adverse conditions that can reasonably be expected given the field conditions and site history) must be illustrated. Historic high groundwater levels as well as current groundwater levels must also be shown on the cross-sections.

Geologic cross-sections shall extend from the top to the bottom of slopes, without regard for property lines. If offsite geologic conditions could influence a site, cross-sections shall be drawn to illustrate those conditions. (This is common for properties located along the south side of Pacific Coast Highway as well as many hillside properties). In addition, cross-section(s) shall be constructed across the site which depict the proposed seepage pits or leach fields, anticipated paths of effluent, recommended capping depths for seepage pits (if applicable), areas where mounded groundwater would occur, and underlying geologic and groundwater conditions.

4.4 Signatures

All final reports must be wet signed by appropriately registered professionals. Reports in hillside areas and all reports that contain geologic interpretations or subsurface exploration of faulting must be signed by a certified engineering geologist. These requirements supersede the requirements of the state discussed in Section 3.4.

4.5 Technical Documentation

All findings, conclusions, and recommendations shall be substantiated by data included within the report. Applicable regional published (and unpublished, if available) geologic reports, maps, aerial photographs, and other technical documents (e.g., geotechnical reports on file with the City) for the immediate area or subject property shall be reviewed and referenced. As a minimum, research of all public (jurisdictional) files for the surrounding area shall be performed. For the purposes of this document, "surrounding area" shall include a minimum 300-foot radius around

the site.

Site-specific field and/or laboratory data and appropriate analyses shall substantiate all recommendations and conclusions. Where professional judgment is utilized to augment the data and analyses, a technical rationale shall be clearly discussed. Potentially hazardous geotechnical processes and site conditions must be disclosed.

4.5.1 Previous Geotechnical Data

All geotechnical data previously collected for the subject site shall be included and properly referenced in the geotechnical report. Consultants shall perform a diligent search for previous data and discuss known geotechnical investigations for the site and include copies of previous reports.

4.5.2 Identification and Mitigation of Risks

The Geotechnical Consultant shall discuss and evaluate each potential geotechnical hazard and either state that such hazard is not present or provide appropriate mitigation measures, with supporting geologic and geotechnical data in either case (See Sections 4.2, 5.1, 6.2.3, and 6.2.9). In situations where such hazards are not identified at the site, the report shall include statements to that effect and provide support for making such statements. For example, CDMG seismic hazard maps could be cited for certain projects, as identified in Section 6.2.7, to support statements that liquefaction or seismically induced landslides are low risks. Another example, is using consolidation data from nearby sites to support statements that foundation settlement due to hydroconsolidation potential is low risk for small projects where extensive laboratory testing is deemed unwarranted and there is no history of hydroconsolidation problems in the area, provided the Geotechnical Consultant is of the opinion that such data is representative of the subject site and the risk is appropriately discussed (see comments below concerning hydroconsolidation). Soil classification data (e.g., dry density, moisture content, degree of saturation, and soil type) can also be useful to support such statements.

In summary, the lack of discussion and evaluation of a particular hazard will not be taken by the Reviewers as a presumption that such hazard does not exist, even if in the opinion of the Reviewer a particular hazard is not present at a site. It is neither the intent nor responsibility of the Reviewer to infer conclusions that a particular hazard is not present. The Geotechnical Consultant must provide appropriate statements for each of the typical geotechnical hazards, and geotechnical reports without such statements will not be accepted.

Although recommendations for mitigating identified risks shall be provided, the risks associated with some hazards cannot be totally eliminated. The risk, however, shall be mitigated to a level of preventing structural collapse, injury, loss of life, or undue financial burden, and the report shall identify for the property owner the level of risk. Acceptable mitigation methods can include recommendations related to site improvement, site drainage, maintenance practices, structural design, and obtaining appropriate insurance. Two examples to illustrate the intent of this statement are given below.

The first example is risk associated with hydrocollapse of supporting materials. For example, hydroconsolidation can result in significant foundation movements in soil/bedrock that exhibit very low potential in the laboratory when water infiltrates to deep depths over a period of time. A well-compacted fill or competent natural deposit, for example, may exhibit a hydroconsolidation strain of only 0.5%, but when integrated over a thickness of say 50 feet results in substantial settlement. A reasonable expectation is to mitigate the risk in the upper 10 to 20 feet to acceptable levels. The geotechnical report, however, shall recognize the potential for risk in deeper materials, inform property owners of such risks, and identify action that property owners can take to reduce the risk. Such action could include checking utility lines for leaks and promptly repairing such leaks, maintaining site drainage and drainage devices, and proper management of landscape watering to reduce the likelihood of water infiltrating the deeper materials.

The second example is the risk of fault rupture. Sites within the fault rupture zone, but not on a fault, may still have a risk associated with fault rupture. The fact that a potential exists, does not mean that projects will be denied a permit, but the risk shall be identified and mitigation proposed. One element of the mitigation may be appropriate insurance.

4.5.3 References

Referenced materials shall include:

- Literature and records cited and reviewed.
- Aerial photographs or images interpreted, listing the type, date, scale, source, and index numbers, etc.
- Compiled data, maps, or plates included or referenced.
- Other sources of information, including well records, personal communications, or other data sources.

4.5.4 Geotechnical Exploration Logs

Geotechnical reports shall include logs of all geotechnical explorations (boring, test pit, and trench logs) on the site, including cone penetrometer data and results of other in situ testing. Each exploration point shall be identified with coordinates (longitude and latitude) and elevation. For trenches, the end of each straight line segment shall be identified. Information that shall be shown on exploration logs or included within the report text includes:

- Names of the responsible field personnel.
- Dates of exploration.
- Exploration method/drill rig type.
- Boring/trench location and elevation, including decimal longitude and latitude coordinates (if available).
- Groundwater observations (indicate time of measurement).
- Drilling method (e.g., hollow-stem auger, bucket auger, wet rotary).
- Sample Depths.
- Hammer (e.g., safety hammer) and sampler (e.g., SPT with or without liners, modified California sampler) details and method of hammer drop (e.g., automatic, cathead and rope with number of wraps) to convert measured sampler blow counts to an equivalent blow count associated with SPT with a delivered energy of 60% (N₆₀).
- Detail of Kelly bar weight and drop height (if applicable).
- Field (unmodified) sampler blow counts.
- Description of excavation backfill.
- Results of field tests (e.g. pocket penetrometer, vane shear).
- Results of soil density and moisture tests and percent fines.

4.5.5 Cone Penetrometer Data

If Cone penetrometer (CPT) data is included, profiles of cone tip resistance, either sleeve resistance or friction ratio, and porewater pressure, when available, shall be provided. Interpreted results, such as soil type, estimated relative density, friction angle, or undrained shear strength of the soil, and equivalent sample blow counts shall be included also. The methodology for interpreting the CPT data shall be cited. The type and size of cone and penetration rate shall be documented

CPT data shall be substantiated by at least one adjacent soil boring with samples analyzed at least for grain-size distribution and compared to interpreted CPT results.

4.5.6 Plans & Cross-Sections

Where a grading permit is required, the geotechnical report shall include a proposed grading plan showing existing and proposed contours from which an appropriate number of cross-sections shall be drawn.

4.5.7 Computer-Assisted Analyses

Engineering analyses assisted by computer programs shall include reference information regarding the software used, and include printouts of applicable input and output files.

5 ENGINEERING GEOLOGIC GUIDELINES

5.1 Seismic Hazard Evaluation

Geotechnical reports shall address all potential seismically induced hazards that may affect the subject property and proposed development, and provide adequate mitigation measures (if necessary).

Seismic hazards shall be evaluated in full conformance with the "Guidelines for Evaluating and Mitigating Seismic Hazards in California" (CDMG, 1997) and the SCEC document, "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California" (SCEC, 1999). Slope stability evaluation shall conform with the guidelines published by ASCE-LA: "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California, organized through the American Society of Civil Engineers, Los Angeles Section (ASCE-LA)".

Where appropriate for quantitative hazard analyses (e.g., liquefaction and seismically induced settlement), ground acceleration values shall be represented by the peak ground acceleration for both unweighted and weighted magnitude (M = 7.5) associated with a 10% probability of exceedance in 50 years. Design accelerations and the probability of occurrence shall be discussed and justified in the report. Data shall be based on earthquake events on faults that may affect the site (i.e., faults within at least 40 miles of the site) using the CDMG fault database.

Any deviations from the CDMG fault database shall be described and justified. Acceptable attenuation curves are (1) Boore, Joyner, and Fumal (1997), (2) Bozorgnia, Campbell, and Niazi, (1999), (3) Campbell (1997), and (4) Sadigh, Chang, Egan, Makdisi, and Youngs (1997). In lieu of a site specific study, ground accelerations can be based on CDMG seismic hazard evaluation report maps.

For all projects within the City of Malibu, geotechnical reports shall include site-specific assessments of seismic hazards for each project. The degree of the assessment may vary with the project type, as explained in the following paragraphs. The fact that a project site is not located within a seismic hazard zone does not obviate the requirement that these hazards be discussed in the report.

The Malibu Coast fault system trends east-west through the City of Malibu. Although all fault branches are not well defined throughout the area, the fault system has clearly been active during the Holocene (the last 11,000 years). Splays of the fault in two areas within the City have been classified by the State Geologist as active, and zoned in accordance with the Alquist-Priolo Earthquake Fault Zoning Act of 1972. This fault system is the southern boundary of the Transverse mountain ranges in which historic earthquakes have had magnitudes of approximately 6.5 on the Richter scale. Consequently, all engineering geologic and geotechnical engineering reports must contain, at a minimum, a site-specific description of the following:

- Regional tectonic setting.
- Location of major fault traces and local known faults near the site based on a review of surrounding geology files, regional maps, FER-229 by the CDMG, and stereo pairs of aerial photographs. Distances from the site to faults within two miles of the site shall be based on appropriate geologic maps and not on fault locations determined by computer programs using the CDMG fault database.
- Fault-rupture hazard evaluation.
- Significant historic earthquakes including epicenter distances, earthquake magnitudes, and estimated intensity at the site.
- Evaluation of ground shaking potential.
- Potential for liquefaction.
- Potential for lurching and topographic-related site effects.
- Potential for lateral spreading.
- Potential for surface manifestations.
- Potential for seismically-induced settlement.
- Potential for earthquake-induced landsliding in hillside areas.

- Tsunami potential, for sites located below an elevation of 35 feet.
- Seiche potential.
- Quantitative evaluation of ground shaking potential, including an evaluation of peak and repeatable high
 ground accelerations, duration of strong shaking, and the effects ground motion due to a minimum 6.5
 magnitude earthquake on the Malibu Coast fault. The effects of such an earthquake on existing or proposed
 structures, underlying earth materials, and slope stability shall be provided.

In accordance with the Seismic Hazards Mapping Act of 1990 (Sections 2690 through 2699 of the Public resources Code), the City of Malibu has been included in the Seismic Hazards Maps for the Topanga, Malibu Beach, Pt. Dume, and Triunfo Pass Quadrangles. These maps are available for review at City Hall and at the CDMG's website. The maps delineate zones within the City that are subject to liquefaction and earthquake-induced landslide hazards. Seismic Hazard Evaluation reports to accompany many of the maps have been prepared by the CDMG and are available at City Hall for review, or in the CDMG's website.

5.1.1 Fault Rupture Evaluation

Engineering geologists are required to trench in a north-south direction across habitable building sites, including single-family residences, multi-family residential units, guesthouses, studios, and commercial buildings, to evaluate fault rupture hazard if the site lies:

- Within an Alquist-Priolo Fault Zone as defined by the CDMG maps. These maps are available for review at City Hall or in the CDMG's website; or,
- Within 500 feet of faults mapped in the CDMG's 1994 Fault Evaluation Report (FER-229) of the Malibu Coast Fault Zone. A copy of this report is available for review at City Hall.

Engineering geologic consultants may utilize existing trench data and exposures on adjacent properties east or west of the subject site in lieu of trenching. The City geologist and engineering geologic consultant will review these on a case-by-case basis.

Where bedrock is available in the near surface, trenches shall be a minimum depth of 2 feet into bedrock. Detailed, illustrated logs of the trenches shall be provided, along with descriptions of all earth units and geologic conditions. A discussion of the findings shall be provided, including conclusions regarding activity of any faults exposed in the excavations. While trenching in beach areas is impractical and unsafe, the engineering geologic consultant shall provide a detailed discussion of faulting in the area utilizing pertinent references and stereographic pairs of aerial photographs. Other forms of site-specific fault rupture hazard investigations are acceptable provided they are conclusive (based on mutual agreement in writing between project engineering geologist and City Geologist.)

5.1.2 CBC Seismic Design Factors

Seismic design factors should be provided in accordance with the CBC and City policy. The CBC design factors that should be discussed in the geotechnical report include:

- Seismic Zone (All of the City of Malibu is located in Zone 4.).
- Soil Type (CBC Section 1636.2 states, "when soil properties are not known in sufficient detail to determine the soil profile type, Type S_d shall be used".). If a soil profile type other than S_d is recommended, the consultant shall discuss and support the recommendation with data.
- Site-Fault Distance (City of Malibu policy requires that all sites located in the City use a Site-Fault Distance of 2 km or less, and a seismic source type of B.).

The 1998 CBC static-force procedure calls for the following seismic geotechnical parameters (near-source factors) N_a and N_v , which are determined from the above items and from the seismic source type (A, B, or C), which depend on

the fault slip rate and maximum moment magnitude. The remaining seismic parameters C_{a_s} C_{v_s} T_{s_s} and T_{o_s} used in structural analyses can be computed from N_a and N_v for seismic zone 4 by the structural engineer.

5.2 Field Exploration Program

Exploration methods shall be sufficient in number and depth to evaluate site conditions and acquire data to justify all conclusions and recommendations. Where applicable, the exploration program shall be coordinated between the Geotechnical Engineer and Engineering Geologist. Subsurface exploration shall be performed in areas most likely to reveal adverse geologic and soils conditions that could impact the proposed development or offsite properties due to the development on the subject site. Conditions to be evaluated include:

- Exploration and documentation of all geomorphic features that suggest the presence of landslides, mud and debris flows, faults, near-surface groundwater, and other possible adverse conditions.
- Descriptions of geologic conditions, including bedding, joints, shears, clay seams, fractures, and physical
 properties of all soils, alluvial deposits, colluvial deposits, weathered bedrock, bedrock, and other earthen
 materials encountered.
- Descriptions and locations of springs, artesian conditions, seeps, perched zones of groundwater, aquicludes, aquitards, and confined and unconfined aquifers.

For all new construction projects, the following minimum exploration program is expected:

- In flat, alluvial areas, borings shall extend below a zone where increases in stress due to imposed loads will
 not negatively impact the performance of the site improvements and sufficiently deep to evaluate
 hydroconsolidation potential that may impact the proposed improvements, liquefaction potential, and the
 potential seismically induced settlement of the site.
- In hillside areas, the depth of borings shall also be sufficient to locate the upper and lower limits of weak zones potentially controlling slope stability. The factor of safety of a potential slip surface passing beneath the maximum boring depth shall exceed 1.5. In hillside areas, more than one boring will generally be necessary to fully evaluate the site for geologic conditions and slope stability. The ASCE-LA guidelines for mitigating landslide hazards provide additional information that shall be referred to when establishing the scope of the field exploration program.
- Sampling intervals shall be at 2- to 3-foot intervals in the upper 10 feet or in the upper 10 feet below cuts and
 at five-foot intervals below or at changes in material types when changes occur more frequently than the
 above sampling intervals.
- Qualified personnel under the direct supervision of a registered geotechnical professional shall log in detail all subsurface excavations. Geotechnical logs that include descriptions of earth units, intervals sampled with uncorrected (field) blow counts, laboratory test results (where appropriate), and logs of the soils and/or geology, must be presented in reports. Downhole logging of geologic borings by an engineering geologist is expected in hillside areas for the detailed evaluation of geologic conditions under the site, unless safety issues preclude downhole logging. If downhole logging is not performed, then appropriately conservative assumptions regarding geologic structure and lithology shall be incorporated in the project. The method of sidewall preparation for downhole or trench logging shall be described in the report.
- For small additions, remodels, and limited construction projects, exploration shall extend to a minimum depth of twice the width of proposed footings <u>below</u> the bottom of proposed footings (e.g. for a 24-inch wide footing, exploration shall extend to a minimum depth of 48 inches below the proposed footing) or a depth of five feet, whichever is greater.

5.3 Excavation Permits

Prior to the excavation of trenches or borings on a site, an excavation permit must be obtained from City geotechnical staff (free of charge). A copy of the permit is attached as Plate G, and copies are available in the Building and Safety Department at City Hall. The permit is to be completed by the geotechnical consultant or applicant along with a map depicting all proposed exploratory excavations on the site. The permit and map may be faxed to City geotechnical staff at 310-456-3356. It should be noted that the geotechnical consultant or applicant must call Dig Alert at 1-800-227-2600 two (2) working days before the work is to begin so the site can properly be marked for utilities. City geotechnical staff will consult with the Planning Department regarding obtaining clearance from archaeological requirements prior to commencing the exploration program. If an initial archaeological evaluation is required prior to commencement of the exploration program on the site, the applicant will be responsible for retaining a qualified archaeologist to do the work. Archaeological reports shall be submitted to the Planning Department for review prior to clearance of the excavation permit. For this reason, applicants/consultants shall consult with the Planning Department regarding archaeological sensitivity of sites prior to scheduling subsurface exploration on a site. Processing of the excavation permit could take at least 2 weeks or more if the site is archaeologically sensitive. Reports for geotechnical investigations conducted without obtaining excavation permits will not be accepted for review.

5.4 Engineering Geologic Conclusions

The scope of conclusions provided in engineering geologic reports depends upon the site-specific soils and geologic conditions and proposed development. Conclusions must be based on a coherent geologic model and substantiated by appropriate geologic data and analyses. Geologic hazards on and adjacent to the site, which affect the site, must be disclosed and addressed by the project engineering geologist. The effects the proposed development will have on adjacent properties shall also be discussed and addressed. Conclusions regarding the following should be included in engineering geologic reports:

- Presence or absence of active faulting across the building site,
- Effects on the site from ground shaking.
- Potential for secondary effects from earthquakes, such as ground cracking and liquefaction.
- Presence of slumping, landsliding, or other slope instabilities on or adjacent to the site, which may affect the site
- The potential for mud and debris flows and rock falls to adversely affect the proposed development (hillside sites)
- Soil and bedrock conditions, including swelling or collapsible soils, that could affect the building site.
- Groundwater conditions and highest anticipated groundwater conditions.
- Feasibility of utilizing a private sewage treatment system on the site.
- Subsidence, settlement, and hydrocollapse potential of the soils on the site.
- Excavation methods.
- Potential for earthquake-induced flooding (tsunamis).
- Presence of contamination (hazardous materials) or other man-imposed conditions encountered at the site (undocumented fill, abandoned water wells, swimming pools, septic systems, etc.).

5.5 Engineering Geologic Recommendations

As a minimum, engineering geologists should make recommendations regarding the following:

- Provide setbacks from faults across building sites (if necessary).
- Designate restricted use areas on a site due to the presence of un-mitigated geologic/geotechnical hazards on the site or adjacent properties. Delineate the areas on the site plan and geologic maps.
- Locate structures on the site based on existing geologic/geotechnical hazards and/or adverse geologic conditions.

- Provide measures to mitigate geologic hazards on a site. Where an existing geologic hazard affects off-site
 property but the existing conditions will not be changed, worsened, or otherwise affected by the proposed
 development, and the hazard does not affect on-site or off-site building areas, the hazard does not require
 mitigation. When it can be demonstrated that the proposed development will not increase the potential for
 failure, mitigation measures will not be required.
- Provide methodology for excavating and moving earth materials (rippability of materials).

5.6 Subdividing Geologic/Geotechnical Hazards

Landslides exhibiting factors of safety below the minimum City of Malibu's standards along with their possible affected areas are considered geologic hazards and may not be subdivided. Lot lines must be located such that the landslide is located entirely within one lot. The hazard may not pose a threat to any building areas on the lot containing the hazard or to the adjacent lots. Each lot must have a building site suitable for development as determined by City geotechnical staff.

Where an existing landslide or other geologic hazard affects an adjacent lot in the same subdivision, it must be mitigated.

5.7 Mandatory Building Code Statements

Geotechnical consultants shall provide a complete finding in accordance with Section 111 of the Malibu Building Code for all proposed developments, including private sewage disposal systems. Where on-site or off-site geologic or geotechnical hazards prohibit the geotechnical consultant from providing a complete 111 statement, the consultant shall:

- Provide recommendations to mitigate the hazard(s) to comply with the standards outlined in the City's Guidelines; or,
- Have the property owners sign, record at the County of Los Angeles recorder's office, and submit to City geotechnical staff an "Assumption of Risk and Release" (ARR) for the hazard. It should be noted that ARR's are generally not allowed for new habitable construction (new residences, guest houses, studios, commercial projects, multi-family projects, etc.). Requests for the option to sign an ARR for new construction may be made on a case-by-case basis to the Building Official. Copies of the ARR are available at the Building and Safety Department counter at City Hall.

6 GEOTECHNICAL ENGINEERING GUIDELINES

6.1 General Guideline Items

General geotechnical report guidelines and field exploration guidelines and requirements are covered in Sections 4 and 5.

6.1.1 Exemption & Requirements for Small Additions & Remodels

In lieu of subsurface exploration for small additions and remodels (on a case-by-case basis), applicants may wish to utilize the City of Malibu's "Alternative Expansive Soil Design" (see Plate H). In lieu of utilizing these designs, geotechnical recommendations may be based upon conservatively assumed, minimum Building Code values for soil bearing capacity and lateral resistance, footing embedment depth below lowest adjacent grade of at least 24 inches, slab and foundation structurally designed in accordance with CBC Chapter 18, Division III, and using a weighted plasticity index of 60 to represent the soil.

6.2 Specific Guideline Items

6.2.1 Laboratory and/or In Situ Test Data

Geotechnical reports shall contain sufficient in-situ and/or laboratory testing data to characterize the subsurface material(s) and to substantiate calculations from which the conclusions and recommendations are derived. The report shall include descriptions of the sample preparation and testing procedures and reference applicable ASTM procedures. In general, laboratory procedures shall be selected that will be representative of the site conditions during and post site development from a geotechnical engineering perspective.

In addition to the presentation of numerical data for all laboratory testing, plots or illustrations of laboratory data are required. Data plots shall be submitted as necessary to substantiate the Consultant's conclusions and recommendations. Numerical and graphical presentations of laboratory data that shall be included in the report are:

- Dry density and moisture content of all samples.
- Compaction curves showing maximum dry density and optimum moisture content.
- Grain-size analyses (sieve and hydrometer).
- Consolidation.
- Shear strength tests with plots consisting of normal stress versus shear resistance (failure envelope), normal stress versus shearing resistance if the normal stress is not constant during the shear test, and shear resistance versus displacement. Shear tests samples are often soaked prior to testing. The degrees of saturation of these test specimens are typically of the order of 80 to 90%. Therefore, reference to the specimens being saturated should not be made routinely unless the data supports that description. Direct shear test on partially saturated samples may grossly overestimate the cohesion that can be mobilized when the material becomes saturated in the field. This potential overestimation of the cohesion shall be considered when selecting shear strength parameters. If the rate of shear displacement exceeds 0.005 inches per minute, the Consultant shall provide data to demonstrate that the rate is sufficiently slow for drained conditions.

An adequate number of soil index tests shall be performed to characterize the expansive nature of the material. At a minimum, soils within the upper 10 to 15 feet shall be characterized with expansion index tests and a weighted plasticity index (per CBC Section 1815).

An adequate number of consolidation tests shall be performed to evaluate hydroconsolidation potential as well as soil compressibility. Laboratory testing shall include both: (1) odometer tests in which hydroconsolidation is simulated, and (2) appropriate soil index testing (e.g., grain-size, Atterberg Limits, dry density, and moisture content). When evaluating hydroconsolidation potential consideration shall extend to depths well below the zone of stress influence of the footings or fill, and tests shall be performed at pressures typical of the magnitude to be encountered under design conditions. Data has shown that sample disturbance can influence the measured compressibility of soils, but hydroconsolidation potential is not appreciably affected by sample disturbance (Houston, Houston, and Spadola, 1988). Sample disturbance will not be accepted as a reason to dismiss data showing significant hydroconsolidation potential without supporting data. Also, a conclusion that soils with a hydroconsolidation potential of less than two percent do not require mitigation will not be accepted. The need for mitigation is based on the magnitude of potential settlement, which is affected by the amount of potential collapse and the thickness of material affected, not on a specified magnitude of strain. If clayey or silty soils are present and/or anticipated, adequate time-rate consolidation testing shall be performed.

Some laboratory testing should be performed to provide a preliminary evaluation of soil corrosivity. The chemical properties of soils can have a deleterious effect on building materials resulting from chemical reactions and electrochemical processes. Tests that can be performed to provide a preliminary evaluation of these potential hazards include pH, chloride and sulfate contents, and resistivity. Appendix B, which was slightly modified from the Los Angeles County Manual for Preparation of Geotechnical Reports, provides a brief discussion of potential hazards due to soil corrosivity and the significance of test results in interpreting the risk of soil corrosivity.

Tests to determine the R-value of potential subgrade materials should be performed when providing pavements sections. When pavement sections are based on presumed R-values confirmation tests should be performed during grading.

6.2.2 Groundwater

The geotechnical consultants shall address the potential variations in groundwater conditions underlying the site and how they affect the existing site conditions and proposed development. The term groundwater, as used in this document, refers to all subsurface water, e.g. seepage, perched water, etc. The consultants must address how the proposed development may affect future groundwater conditions and how these changes may affect the development. Highest anticipated groundwater levels that affect the strength of the materials under the site must be utilized for all analyses. As a minimum, the following items shall be addressed and incorporated in the groundwater assessment:

- Groundwater data such as reference to the current water level or piezometric head, seasonal changes along
 with historic high and historic low water tables, if available. For new construction projects, subsurface
 exploration is necessary to determine current groundwater levels underlying the site.
- The effects of effluent from the proposed private sewage treatment system on groundwater levels.
- The effects of irrigation on groundwater levels.
- The effects of potential heavy rainfall (such as the 1969, 1978, 1980, 1983, 1986, 1993, 1995, and 1998 rainfall years in California).
- The potential for geotechnical hazards associated with groundwater (such as seepage, shallow groundwater, springs, artesian conditions, etc.).

6.2.3 Slope Stability Analyses

6.2.3.1 General

Stability shall be analyzed along all critical cross-sections where development includes or is adjacent to slopes with a gradient steeper than 4:1 (horizontal:vertical). Slopes with a 4:1 gradient or shallower which include a geologic/geotechnical hazard such as a landslide will require stability analyses. The critical cross-section is defined as the slope with the most adverse conditions, such as the steepest gradient, highest slope, most adverse geologic conditions, groundwater conditions, weakest soils and bedrock, etc. More than one cross-section may be considered the most critical on a geotechnically more complex site. The critical failure surface should be identified and evaluated on each cross-section. Slope stability evaluations should consider as a reference the guidelines published by ASCE-LA: "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California, organized through the American Society of Civil Engineers, Los Angeles Section (ASCE-LA)". Subsurface geologic and groundwater conditions must be sufficiently evaluated and illustrated on geologic cross-sections and must be utilized by the geotechnical engineer for the slope stability analyses. If on-site sewage or storm water disposal exists or is proposed, the slope stability analyses shall include the effects of the effluent plume on slope stability.

All reports in hillside areas shall address the potential for surficial instability, debris/mudflow, rockfalls, and soil creep on all slopes that may affect the proposed development or be affected by the proposed development. Stability of slopes along access roads shall be addressed.

6.2.3.2 Soil Creep

The potential effects of soil creep shall be addressed where any proposed structure is planned in close proximity to an existing fill slope or natural slope. The potential effects on the proposed development shall be evaluated and mitigation measures proposed, as appropriate, including appropriate setback recommendations.

6.2.3.3 Surficial Stability

Surficial slope stability refers to slumping and sliding of near-surface sediments and is generally most critical during the rainy season or with excessive landscape watering. The assessment of surficial slope stability shall be based on analysis procedures for stability of an infinite slope with seepage parallel to the slope surface or an alternate failure mode that would produce the minimum factor of safety. The minimum acceptable depth of saturation for surficial stability evaluation shall be four (4) feet. All conclusions shall also be substantiated by appropriate analyses and data. Shear strengths shall be based on fully (100%) saturated samples tested at overburden pressures representative of the upper four feet of material. If the surficial stability assessment indicates a computed safety factor of less than 1.5 that could affect the proposed building site, mitigation measures shall be provided. Surficial stability analyses shall be performed under rapid draw-down conditions where appropriate (e.g., for debris and detention basins).

6.2.4 Gross or Deep-Seated Stability

Gross stability includes rotational and translational deep-seated failures of slopes or portions of slopes existing within or outside of the proposed development. The following guidelines, in addition to those in the ASCE-LA document, shall be followed when evaluating slope stability:

- Stability shall be analyzed along cross-sections depicting the most adverse conditions (e.g. highest slope, adverse bedding planes, steepest slope). Often analyses are required for different conditions or more than one cross section to demonstrate which condition is most adverse. The critical failure surfaces on each cross-section shall be identified, evaluated, and plotted on the large-scale cross section.
- For all new construction of habitable structures, including single-family residences, guest houses, studios, multi-family residential projects, and commercial projects, and swimming pools (see guidelines, Plate F), the minimum required long-term factor of safety is 1.5, minimum pseudo-static factor of safety is 1.1.
- If the long-term, static factor of safety is less than 1.5, mitigation measures will be required to bring the factor of safety up to the required level or the project may be re-designed so as to achieve a minimum factor of safety of 1.5. The minimum required factor of safety for temporary (during construction) excavations is 1.25.
- Long-term stability shall be analyzed using the highest known or anticipated groundwater level based upon a groundwater assessment performed under the requirements of Section 6.2.2.
- Strengths utilized for design shall be no higher than the lowest computed using back calculation.
 Assumptions regarding pre-sliding topography and groundwater conditions at failure must be discussed and justified. If the calculated factor of safety for a landslide mass is above the value that existed at the time of failure, it shall be shown what changes have taken place to result in the safety factor increase.
- The report shall describe how the shear strength testing methods used are appropriate in modeling field conditions and long-term performance of the subject slope. The utilized design shear strength values shall be justified with laboratory test data, geologic descriptions and history, along with past performance history, if known, of similar materials.
- Shear strength values higher than those obtained through site-specific laboratory testing will not be accepted.
- If direct shear or triaxial shear testing is utilized to model the strength of highly jointed and fractured rock
 masses, the design strengths shall be cross checked with shear strengths obtained from the overall rock mass
 quality and be consistent with rock mechanics practice.
- Multiple shear tests shall be performed on each material type to evaluate material variability.
- Direct shear tests do not always provide realistic strength values (Watry and Lade, 2000). Correlations
 between liquid limit, percent clay fraction, and strength (fully softened and residual) by Stark and McCone
 (2002) will be used during the review process to evaluate strength parameters used by Consultants. Strength
 values used in analyses that exceed those obtained by this correlation must be justified.
- Shear strengths for proposed fill slopes shall be evaluated using samples mixed and remolded to represent anticipated field conditions. Confirming strength testing may be required during grading.
- Design shear strengths for fill slopes shall be consistent with anticipated long-term movements and obtained from samples that have been soaked in an effort to reach saturated conditions.
- Coordinates of the potential slide planes within the lowest safety factors for each mode of failure (rotation, block) should be depicted on cross-sections utilized in the analyses.
- The stability analyses model shall consider and incorporate all adverse geologic conditions such as joints, fractures, shears, faults, bedding planes, clay seams, gouge zones, clay beds, and landslide rupture surfaces.

- Circular and non-circular potential slip surfaces shall be utilized, as appropriate.
- Tension cracks and anticipated external loading shall be modeled, as appropriate.
- Critical failure surfaces should be depicted on the cross-sections utilized in the analyses.

6.2.5 Seismically-Induced Slope Instability

Seismically induced slope stability analyses are required in all cases where static or gross slope stability was performed. The slope stability evaluation should conform with the guidelines published by ASCE-LA: "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California, organized through the American Society of Civil Engineers, Los Angeles Section (ASCE-LA)".

6.2.6 Construction Stability

The report shall evaluate the construction stability (temporary stability) during grading, foundation construction and retaining wall excavations. See Sections 6.2.4 and 7.4 for discussion of minimum factors of safety, shoring and temporary excavations.

6.2.7 Liquefaction

Geotechnical consultants shall address the potential for liquefaction to occur at the site (including lateral spread and seismically-induced settlement) and identify whether the site is located within a Liquefaction Hazard Zone based upon the Seismic Hazards Maps published by the CDMG, experience in the City of Malibu, or review of geotechnical studies on adjacent sites.

Proposed new development that qualifies as a project, as designated by the Seismic Hazards Mapping Act (1990) (and as defined in the California Public Resources Code sections 2621.6 and 2693), and is located within state-designated liquefaction hazard zones must perform a comprehensive liquefaction evaluation (including a quantitative) in conformance with CDMG Special Publication 117. The project geotechnical consultant should evaluate the liquefaction potential in general accordance with the *Guidelines for Analyzing and Mitigating Liquefaction in California* (Southern California Earthquake Center, March 1999). Deviations from the guideline should be described and justified.

If an adequate factor of safety against liquefaction cannot be demonstrated (factor of safety against liquefaction must exceed 1.25), and it is determined that the effects of liquefaction exceed tolerable levels, mitigation measures to minimize the effects (i.e., preventing structural collapse, injury, loss of life) shall be provided.

In the case of one- and two-story single-family residences, a comprehensive liquefaction evaluation in conformance with CDMG Special Publication 117 is required when the site is located within a Liquefaction Hazard Zone. If, however, the site is not within a Liquefaction Hazard Zone and liquefaction is not considered a hazard at the site, then a rationale for that conclusion shall be provided. A rationale may consist of a site not being within a Liquefaction Hazard Zone and the Consultant being of and stating the opinion that the depth to groundwater, density and age of underlying materials, or other factors (all appropriately referenced), are sufficient to preclude the risk of liquefaction.

Comprehensive liquefaction studies are not required for swimming pools and spas, remedial repair projects, or additions and remodel projects, but the potential for liquefaction must be discussed. If the site is within a Liquefaction Hazard Zone, the report shall clearly inform the property owner of the risk, the potential consequences to the proposed improvements, and methods available to quantify the risk.

While the Seismic Hazards Mapping Act defines "residential project" subject to the act as developments of 4 or more dwellings, the Act does not prohibit the City from establishing guidelines which are more strict than those established by Chapter 7.5 (Section 2624). The City will require geotechnical studies for all new habitable structures as defined in

earlier sections. Remodels and additions to existing structures, as well as accessory non-habitable structures, are exempt in that the homeowners may sign and record an "Assumption of Risk and Release" (ARR) for liquefaction hazard.

6.2.8 Seismically Induced Settlement

Granular soils, in particular, are susceptible to settlement during seismic shaking, whether the soils liquefy or not. The potential for seismically induced settlement to a depth of 50 feet shall be quantified for all projects except small additions and remodels, swimming pools and spas, and repairs. For these exempted projects, a discussion of the risk, however, shall be provided in the report.

Portions of the City of Malibu are underlain by dense deposits. For a magnitude 7.5 earthquake with a peak ground acceleration of 0.6g, the computed seismically induced settlement in a 50-foot thick, dense, dry, granular deposit with a SPT blow count ($N_1|_{60}$) of 30 is less than 0.5 inches. The computed settlement reduces to about 0.25 inches if the sampler blow counts are 40. If, however, the groundwater is at the surface, the computed seismically induced settlement is about 3.5 inches in a deposit with a SPT blow count of 30 to a depth of 50 feet, decreasing to about 0.5 inches when the blow counts increase to 35, and to a negligible amount if the blow counts are 40. If the groundwater is at a depth of 25 feet, the computed seismically induced settlement is about 1.5 inches in a deposit with a SPT blow count of 30 to a depth of 50 feet.

When selecting the depths of borings to quantify seismically induced settlement to a depth of 50 feet, consideration can be given to geologic conditions at the site. It is only necessary to extend the borings to a depth where the deeper soils are expected to be sufficiently dense, based on geology, exploratory data in the area, and experience, that the estimated seismically induced settlement to the depth explored plus the amount anticipated for materials between the depth explored and 50 feet, assuming the highest anticipated groundwater, is within tolerable amounts or adequately mitigated. The presentation of results within the geotechnical report shall clearly present the rationale and supporting data when site specific data is not determined to a depth of 50 feet.

6.2.9 Settlement/Heave

Foundation and slab movements may result from settlement caused by seismic shaking and/or compression of supporting materials caused by live and dead loads of the foundations, settlement of compacted fill and underlying materials due to the weight of compacted fill, and swell or hydroconsolidation of supporting materials if moisture infiltrates these materials. The geotechnical consultants shall analyze and estimate future total and differential movements of all footings, slabs, pipelines, and engineered fills supporting structures. The subsurface profiles used for settlement analysis shall be shown in cross-section and be substantiated by subsurface data. Settlement analysis calculations shall be submitted. If professional judgment is used in addition to or to modify the calculated settlement, justification or rationale upon which the judgment is made shall be provided.

The magnitude of total and differential settlement shall be provided along with the computations. The estimated time for settlement to be 90% complete along with computations shall be provided where significant settlement is anticipated. Vertical movement estimations shall, as a minimum, consider:

- Seismically induced settlement (See Section 6.2.8).
- Compression of the fill materials due to their own weight.
- Compression/consolidation of subsurface materials underlying fill.
- Secondary consolidation, if it exists, of both fill and underlying subsurface materials.
- Hydroconsolidation of fill and underlying subsurface materials (See Sections 4.5.2 and 6.2.1).
- Settlement of foundations due to dead and live loads.
- Potential heave due to swelling (expansive) soils (EI > 20).

A settlement-monitoring program shall be implemented during and after construction in situations where the anticipated settlement of fill and underlying materials, due to the added weight of fill, exceeds one inch (e.g. thick fills

or fills overlying soft materials). Settlement monitoring shall consist of surface monuments and subsurface settlement plates.

7 GEOTECHNICAL ENGINEERING RECOMMENDATIONS

The following comments are intended to serve as a guide to the Geotechnical Consultant as to items the Reviewers will look for when reviewing geotechnical recommendations. The list, however, is not intended to be exhaustive. A number of additional issues have been identified in Sections 5.1 through 6.2.9. The Consultant must address each of the issues with supporting information. The Reviewers will not assume that unmentioned items are unimportant or do not need mitigation, even if in the opinion of the Reviewer such is the case. The geotechnical consultant has the responsibility to identify and discuss each issue, and provide mitigation measures if necessary.

7.1 Foundations

7.1.1 Shallow Foundations (e.g., wall and spread footings)

Design of shallow foundations shall include the following recommendations that are applicable:

- Allowable bearing pressure. The minimum safety factor shall be stated when the allowable bearing pressure exceeds 3000 psf.
- Minimum slope setback (CBC Section 1806.5).
- Estimated total and differential settlement.
- Resistance to lateral loads (passive soil resistance and/or base friction) specified as ultimate or allowable with recommended safety factors. Safety factors must equal or exceed 1.5. A one-third increase in resistance for temporary (e.g., wind, seismic) loading will not be allowed for passive and base friction resistances, unless the safety factors for static conditions exceed two. If the recommended passive or sliding soil resistance relies on a cohesive strength component, the shear strength parameters shall be based on drained tests at overburden pressures representative of the application (less than 250 psf for shallow footings) and on samples that have been soaked and have a degree of saturation of 100%. Cohesions measured on partially saturated (< 100%) samples will not be allowed to compute lateral resistances for shallow footings.
- Requirements for compacted fill pads or over-excavation and recompaction.

7.1.2 Deep Foundations

Design of deep foundations shall include each of the following that are applicable:

- Allowable vertical loads (compression and uplift) as a function of foundation size, specify skin friction or end bearing, and safety factors used. Safety factors must equal or exceed 3.
- Pile or caisson-tip elevations corresponding to minimum depths of embedment.
- Feasible pile and/or caisson types.
- Potential for negative skin friction and effects on allowable vertical loads.
- Lateral resistance from earth pressures.
- Forces acting on the piles resulting from external loads, including soil creep, the effects of lateral spreading, and surcharge from adjacent structures or to achieve the appropriate factor of safety against slope failure.
- Deflections of laterally loaded piles under design loads.

7.1.3 Pool Foundations

The geotechnical consultant shall provide specific recommendations for the design of pool foundations to mitigate adverse settlement or expansion that may lead to leakage. Recommendations for swimming pools and spas shall include lateral soil pressures acting on the walls, type of supporting materials, and recommendations for a subdrain or hydrostatic relief value. (see Plate F)

7.2 Slab-On-Grade Construction

All slab-on-grade construction shall, as a minimum, conform to CBC Chapters 18 and 19 and Appendix Chapter 18. To provide a more competent foundation system for single-family residences supported with a slab-on-grade, the geotechnical consultant shall give consideration to recommending that the concrete for the slab and footings be poured as a monolithic unit and that a fiber-reinforced concrete be used to augment (not replace) steel reinforcement. Fiber reinforcement improves the tensile strength of concrete and reduces the likelihood of shrinkage cracks from developing. Granular subgrade material is required for all slab-on-grade construction on expansive soils or requiring damproofing, per Section 7.2.2 of these guidelines.

7.2.1 Vapor Barrier Requirements

Recommendations for vapor barriers shall conform to CBC Appendix 18 and be a minimum thickness of 10 mils.

7.2.2 Expansive Soils

Specific foundation recommendations to mitigate the effect of expansive soils will be required for all foundations, slab-on-grade, and pools placed on soils with an expansion index value over 20.

7.3 Retaining Structures

7.3.1 Standard Retaining Walls

Standard retaining walls are those gravity walls consisting of reinforced concrete or masonry block. Depending on the proposed development and site conditions, the report shall contain recommended earth pressures for proposed retaining structures. The design pressures should consider and/or incorporate:

- Type of backfill (e. g. sand, silty sand) and recommended lateral pressures should be compatible with the type of backfill with higher pressures associated with soils having a higher fine content.
- Existing and proposed surcharges.
- Slopes, adversely oriented geologic features (bedding, joints, fractures, etc.) and any other factors that may affect the lateral loads.
- Wall restraining conditions (deformation conditions).
- Backfill placement requirements, including temporary excessive equipment loading, if any.
- Appropriate shear strength for backfill materials, in-place materials and structure support materials.
- Effects and pressures from expansive soils.
- Effects of creep-prone materials.

In addition, the report shall contain the following design parameters/items:

- Coefficient of friction against sliding.
- Back drainage design and waterproofing, including size of piping, volume and specification of gravel, and height and width of gravel and earthen backfill.
- Surface drainage requirements.

For walls that are retaining slopes, the amount of freeboard to prevent sloughing over the wall shall be ascertained.

For walls that are retaining slopes that are subject to either surficial failure, debris flows and/or mudflow, appropriate design criteria to compensate for the effects of impact of debris or mud flow (earth flow) must be incorporated into the design. Catchments for potential earth flows must also be considered. Calculations and/or assumptions shall be provided.

Retaining walls higher than 12 feet shall be designed to resist additional earth pressures caused by seismic shaking.

7.3.2 Non-Standard Retaining Structures

Non-Standard Structures are defined as retaining walls not composed of reinforced concrete or masonry block. Examples of non-standard retaining walls include crib walls, segmented-block walls, and reinforced earth walls. In addition to the aforementioned requirements, the following items must also be considered for non-standard retaining structures:

7.3.2.1 Cribwalls/Reinforced Earth Walls

Adequate stability analyses must be performed to show that the integrity of the wall is maintained. All pertinent manufacturers specifications and recommendations shall be included in the report. All walls shall contain appropriate backdrainage for the entire height of the wall. Walls shall be backfilled with free-draining clean sand or gravel, including backfill within the cells of the cribwalls, unless it is demonstrated that alternatives will perform acceptably. No structures shall derive any support from non-standard retaining walls unless it can be demonstrated that the vertical and lateral movements will be tolerable.

7.3.2.2 Other Non-standard Retaining Walls:

A sufficient number of case histories may be required to substantiate the performance of the proposed walls under similar loading conditions.

7.3.2.3 Surcharge Behind Retaining Walls

The geotechnical consultant should evaluate the potential for vertical and lateral surcharge on retaining walls due to adjacent structures, footings, traffic load, etc. A surcharge source located below a 1(H):1(V) plane could laterally surcharge retaining walls. Hence, using the 1(H):1(V) criterion to preclude the potential for lateral surcharge of retaining walls is not acceptable unless substantiated by appropriate analyses (e.g. methods of analysis presented in NAVFAC DM7.2).

7.4 Shoring and Temporary Excavations

Shoring systems are usually temporary supporting structures used to retain earth until the structure is completed. Shoring design parameters are used to determine the loads the retained soil will impose on the shoring units and must be provided by the soils engineering consultant. The geotechnical consultant shall evaluate the construction stability (temporary stability) during grading, foundation construction, and retaining wall excavations. All shoring shall be designed in accordance with the following criteria, and the stability evaluation section of the report shall, at a minimum, include the following:

- A stability analysis model that considers and incorporates all applicable geologic discontinuities such as joints, shears, fractures, bedding planes and faults.
- Shear strengths utilized should represent worst-case conditions anticipated at the time of excavation. Soil peak shear strength parameters may be utilized, however, to compute the shoring loads.
- Tension cracks and anticipated external loading shall be modeled as appropriate.
- Construction stability shall be analyzed on all potential critical cross-sections. The critical failure surface on all cross-sections, should be identified and evaluated.
- Construction stability should be analyzed utilizing worst-case groundwater levels anticipated at the time of excavation.
- All temporary excavations shall possess a minimum factor of safety of 1.25. If the factor of safety is less than 1.25, remediation/mitigation to bring the safety factor up to 1.25 will be required.
- Geotechnical consultants recommending shoring shall provide a geotechnical design including, but not limited to, active and passive pressure magnitudes and lateral pressure distributions, type of shoring, the location and magnitude of any external loads that may affect the design and/or performance of the shoring systems, and minimum embedment for the restraint system.
- If a slot cut type system is utilized, analysis will be required to demonstrate the stability of excavated slots.
- All trench shoring must conform to the provisions of the California Labor Code/State Construction Safety

Orders. These regulations can be obtained from CAL-OSHA. Applicable requirements of CAL-OSHA shall be discussed and incorporated into the excavation stability assessment.

The geotechnical consultant shall address whether any construction dewatering will be necessary for the proposed excavations. The effects of the dewatering on adjacent existing structures/properties should be evaluated.

The geotechnical consultant shall address the amount of anticipated deformation during construction and its effect on existing adjacent structures. The need for deformation monitoring during construction should also be addressed (if applicable).

If an excavation affects the stability of existing structures and/or off-site property, shoring must be designed and installed to eliminate the hazardous condition. The design must be in accordance with all standards in this Guideline and must consider all factors such as slope stability, settlement, creep, etc. The soil strength parameters must be in accordance with the applicable criteria and shall not exceed the test values noted in the soils engineering report.

7.5 Grading Recommendations

The report shall contain sufficient and appropriate grading recommendations for the proposed grading in accordance with the City's Grading Codes (Ordinance 51U). Grading recommendations shall also specify the depth and extent of the materials underlying the proposed foundations. If removal and recompaction is recommended, minimum removal depths referenced to the bottom elevation of the proposed foundations should be specified and be consistent with the settlement estimates.

7.5.1 Removal and Recompaction

Grading recommendations shall include comments on clearing and grubbing, removal of old fill, debris, and abandoned tanks and septic systems. Also, recommendations for the minimum depth and extent of the materials underlying the proposed foundations that need to be removed and recompacted shall be discussed. The report shall specify the minimum distance beyond the outside edge of shallow foundations for removal and recompaction, as determined by the engineer (typically 5 feet). The report shall provide recommendations for a foundation system that will mitigate or reduce the effects of excessive settlement or heave (e.g. to a level in which service related problems such as non-functioning doors and windows or excessively sloping slabs would not occur). Minimum removal depths referenced to the bottom elevation of the proposed foundations shall be specified and be consistent with the settlement estimates.

7.5.2 Subdrains

Location and design specifications for subdrains, back drains and other subdrain systems shall be included in the geotechnical report. This shall include, but not be limited to, outlet location, size, gravel pack, flow gradient, filter fabric, etc. Additionally, the need for cut-off walls, glued joints, vertical and horizontal drains and design specifications shall be included. Subdrains should be installed beneath all pools, and under all other water amenities (spas, fountains, ponds) when located in critical areas sensitive to subsurface water.

7.5.3 Cut/Fill Transition Areas

Foundations and pipes located in cut/fill transition areas and over variable thicknesses of fill may be subject to differential movements due to different stiffness characteristics and different hydrocollapse potential of the different supporting materials. Furthermore, structures on cut/fill lots have not performed well during seismic events. Consideration shall be given to potential differential foundation movements in such cases, and recommendations shall be provided to mitigate the risk of differential movements. Building pads located in cut/fill transition areas, for example, may be over-excavated to provide a relatively uniform thickness of fill below the bottom of the proposed footings. As a minimum, fill thickness beneath foundations in cut/fill lots shall be at least three feet, unless an alternative recommendation is justified on a site-specific basis. Recommendations for structural mitigation in the form

of extra structural reinforcement of slabs and footings shall be provided, as necessary.

7.5.4 Organic Content in Fills and Backfills

All certified fills and backfills should meet the provisions of the current edition of the City Building Code. Whenever the organic content percentage as performed in accordance with ASTMD2974-87, Method C or D exceeds two (2) percent, the material shall be considered detrimental and will not be acceptable. Treated wood lagging is NOT considered organic content.

7.5.5 Existing Fills

Grading plans must show all existing fills on a site and classify these fills as certified or uncertified, as well as identify all buttress fills. For any grading involving cutting into an existing fill slope, the geotechnical consultant must characterize the fill slope and provide slope stability analyses for the proposed and as-built conditions.

7.5.6 Fill Slopes

The Consultant shall include recommendations for keyways, benching, and drainage details.

7.6 Drainage

All surface runoff must be carefully controlled and must remain a crucial element of site maintenance. Proper drainage and irrigation are important to reduce the potential for damaging ground/foundation movements due to hydroconsolidation and soil expansion or shrinkage and for mitigating adverse effects due to erosion that may endanger the integrity of the graded site, foundations, or flatwork. The geotechnical report shall specify the need for and reasons why drainage and maintenance practices are required for satisfactory performance of foundations and slabs.

The geotechnical report shall discuss and include, as appropriate, recommendations for (1) minimum slope gradients and distance for drainage away from foundations, (2) installing roof drains, areas drains, catch basins, and connecting lines, (3) drainage beneath raised floors, (4) managing landscape watering and maintenance of drainage devices, (5) waterproofing systems for walls and floors when dealing with basements or when landscaping mounds are constructed against buildings, and (6) maintenance guidelines for property owners. Planter boxes located adjacent to foundations shall have a water-tight base and be connected to an acceptable drainage system. Subdrains shall be installed below ponds and fountains.

In addition, the following items must be addressed in the geotechnical report:

 Data from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) should be reviewed and included if a flood zone is shown on or adjacent to the proposed development in order to assure that all flood hazards which may affect the geologic and/or geotechnical environs have been considered (i.e., flood of septic system, erosion of graded surfaces, saturation of materials below the footings, malfunction of drains, and other possible effects). Please contact the Public Works Department regarding this matter

7.7 Construction Observation and Testing

- All fill placement and compaction shall be under observation and testing by the Geotechnical Consultant.
- The Geologic Consultant shall observe all excavations in bedrock formational materials.
- Grain-size analyses shall be provided for all compaction curve samples.
- One duplicate sand cone test shall be performed for every four nuclear-gage tests.
- The Project Engineer shall observe the foundation excavations during construction and verify the design assumptions.

- Geotechnical observation, including verification of pile tip depth and clean-out of pile drill-holes is required for the installation of drilled deep pile foundations.
- When driven piles are used, the geotechnical consultant shall confirm that field driving records are consistent with the engineer's design assumptions.
- Recommendations by the project geotechnical consultant are required when shoring or underpinning adjacent
 to public right of ways or private existing developments. Provisions to monitor ground deformation to
 adequately protect and inspect the conditions of infrastructure, buildings, streets, and walkways shall be
 made.